**2008 Pierce's Disease Research Symposium** **Roundtable 1**
**Conclusion Recorder's Sheet**

## Topic A. What cues allow glassy-winged sharpshooters to identify and select their hosts?

| | Name | email | Cell telephone | Hotel |
|---|---|---|---|---|
| Facilitator | Roger Innes | | | |
| Conclusion Recorder | Roger Innes | | | |

2.5 participants

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| Conclusion 1<br><br>Host plant finding involves a hierarchy of decision making by the insect, in space (distant from the plant to close) and time (before contact with the plant and after contact).<br>(1) Visual cues, e.g. green color.<br>(2) Olfactory, at medium range.<br>(3) Visual (e.g., leaf shape and color).<br>(4) Contact, after landing and involving mechano-sensing by several organs.<br>(5) Taste sensing, e.g. gustatory and mechanical assessment of the xylem sap and nearby structures. |
| Conclusion 2<br><br>The olfactory cues for leafhoppers remain mostly unknown. Research on the volatiles of non-preferred and preferred plants of GWSS could reveal GWSS repellents and attractants (examples of research in this area from Sanford Eigenbrode, University of Idaho). Usually a single deterrent will not be sufficient, and the combination of a deterrent in the crop and an attractant trap crop will be more effective (push-pull strategy). |
| Conclusion 3<br><br>Host acceptance for GWSS occurs after the insect has settled on a plant and is dependent on finding xylem fluid and accepting the taste. If the xylem fluid is moderately deterring, multiple probing, and more effective *Xf* transmission, may follow. If the deterrent is strong, it is possible that there will be no repeated probing. |
| Conclusion 4<br><br>Although hemiptera do not rely on acoustic signals as a cue for identifying host plants, they may be sensitive to signals in the form of substrate vibration. It is conceivable that a selected audio-range signal could be imposed on the trellis wires of a vineyard to provide a substrate vibration that the GWSS would find unacceptable. |

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## Topic B. Which parasitoids show the greatest promise as control agents for the glassy-winged sharpshooter?

| | Name | email | Cell telephone | Hotel |
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| Facilitator | David Morgan | | | |
| Conclusion Recorder | David Morgan | | | |

7 participants

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| Conclusion 1<br><br>*Gonatocerus ashmeadi* is currently the most effective parasitoid, but it has limitations, specifically poor overwinter survival and lack of success in the desert and coastal environments. |
| Conclusion 2<br><br>*G. morgani* and *G. morrilli* are two parasitoids with potential for improving biological control, since they may be able to fill niches not utilized by *G. ashmeadi*. Other candidates are possible. |
| Conclusion 3<br><br>Biological control, as a stand-alone strategy, is unlikely to suppress GWSS sufficiently for PD eradication, but biological control would be improved greatly by:<br><br>(1) Finding an agent that can survive periods without hosts (e.g., be able to overwinter), and<br><br>(2) Developing an economical method for mass rearing of GWSS parasitoids.<br><br>Two species of potential value currently are in quarantine. One, *Pseudoligosita* sp., a Trichogrammatid from Mexico, has overwintering attributes and may be easier to rear than current parasitoids. |

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Topic C. How can glassy-winged sharpshooter trapping data be collected more efficiently and used more effectively in the mitigation of Pierce's disease?

| | Name | email | Cell telephone | Hotel |
|---|---|---|---|---|
| Facilitator | Blake Bextine | | | |
| Conclusion Recorder | Gevin Kenney | | | |

7 participants

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| Conclusion 1<br><br>State-wide traps should be bar-coded and GPS documented to improve the value of the data. |
| Conclusion 2<br><br>Trapping can provide more information than at present, such as testing for the presence of *Xf*. However, the additional data would require significantly greater investments of money, time, and effort. Data on *Xf* would be of value both for improving control measures (e.g., more rapid response from growers) and increasing basic understanding of *Xf* spread. |

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## Topic D. Follow-up to panel discussion: glassy-winged sharpshooter management.

| | Name | email | Cell telephone | Hotel |
|---|---|---|---|---|
| Facilitator | Judy Stewart-Leslie | | | |
| Conclusion Recorder | Tom Miller | | | |

5 participants

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| Conclusion 1<br><br>It is recommended that traps in Fresno should be coordinated with GPS, and the results should be posted on the CDFA field board. |
| Conclusion 2<br><br>Almond growers in Bakersfield north are not demanding GWSS control. |
| Conclusion 3<br><br>Crepe myrtle is abundant in the Fresno urban area; it is susceptible to GWSS. |
| Conclusion 4<br><br>Trap catch can depend on the monitoring crew disturbing the host plants. Would different crews produce a different catch from the same traps because they operate slightly differently? |
| Conclusion 5<br><br>Treatments need to be based on the previous year's trap catch, because treatment plans cannot wait for the current year's trap catch Karen Franconi, Fresno County |
| Conclusion 6<br><br>There should be an effort to express thanks to property owners who cooperate in GWSS suppression activities. They should be informed of the critical need of the program and the program's successes. |

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| Topic E. What *Xylella fastidiosa* genes are necessary for success of the bacterium in infected grapevine? |
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| | Name | email | Cell telephone | Hotel |
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| Facilitator | Paulo Zaini | | | |
| Conclusion Recorder | Tom Burr | | | |

25 participants

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| Conclusion 1<br>Only a few genes have been correlated with *Xf* "success" in grapevine. These include PG, TolC and pil genes for movement and biofilm development. TolC is absolutely essential for virulence whereas the others are associated with movement and ability to move across pit membranes. |
| Conclusion 2<br>Some genes that suppress disease – dsf for example – may in fact also play a role in bacterial "success" in the plant. DSF acts to suppress cell density, movement, and likely other functions that are yet to be identified. |
| Conclusion 3<br>Glucanase genes may also play a role in survival of *Xf*, acting at the pit membranes and to digest fastidian gum. However, glucanase alone is not sufficient to open pit membranes. |
| Conclusion 4<br>Genes that mediate success in the plant may be counter productive in *Xf* transmission. For example, hemagglutinin mutants, which result in hypervirulence in the plant, are defective in transmission. |
| Conclusion 5<br>Gene expression studies show great differences for bacteria in a rich medium vs, bacteria in a plant. Type V secretion system now has been shown to be essential for export of proteins that affect virulence. |
| Conclusion 6<br>Mutations in GacA and AlgU reduce virulence. Both regulatory genes are up-regulated in *Xf* cells exposed to grapevine xylem sap. |
| Conclusion 7<br>The presence of pectinase in media is positively correlated with *Xf* mobility and growth. |

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## Topic F. How can a trap cropping system be developed using a GWSS host plant species that is immune to *Xf*?

| | Name | email | Cell telephone | Hotel |
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| Facilitator | Joao Lopes | | | |
| Conclusion Recorder | Isabelle Lauziere | | | |

5 participants

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| Conclusion 1<br><br>The approach taken will not be identical when applied in different regions. It must take into account local conditions, the vectors that are involved, whether the infection is primary or secondary, and whether or not the *Xf* strains are causing symptoms in grapevine. |
| Conclusion 2<br><br>Some plant species that do not serve as a reservoir for the grapevine strain of *Xf* are preferred for this approach. The plants must be good hosts for the vector, and they can and should be used in concert with chemical applications to reduce vector populations and vector transmission. |
| Conclusion 3<br><br>The corridor or entry point of the vectors needs to be known in order to properly position the trap crop plants on a path that will maximize vector catch. |
| Conclusion 4<br><br>Phenology of the plant matters and is site specific. |

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| Topic G. OPEN TOPIC |
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| Topic selected: Biotechnological approaches to vector control. |
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| | Name | email | Cell telephone | Hotel |
|---|---|---|---|---|
| Facilitator | Melody Meyer | | | |
| Conclusion Recorder | Jeremy Warren | | | |

5 participants

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| Conclusion 1<br>Use a virus-based expression system where a recombinant virus carries an iRNA gene aimed at controlling GWSS. This can be done in a plant- or insect-based system. |
| Conclusion 2<br>Transgenic trap crops based on iRNA or other approach (e.g., protein expression) are aimed at reducing GWSS population. Using the trap crop rather than the crop should reduce regulatory hurdles. |
| Conclusion 3<br>Use an endophyte or avirlulent *Xylella* to deliver iRNA or protein in grapevine. Is there a system for iRNA secretion from bacteria? Another problem is the lack of good candidate endophytes, since most do not survive long in grapevine. Protein expression and export would seem to be a better option than iRNA. |

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## Topic H. What approaches/strategies/regimens would allow insecticide application and parasitoid release to be used simultaneously in GWSS control?

| | Name | email | Cell telephone | Hotel |
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| Facilitator | David Morgan | | | |
| Conclusion Recorder | David Morgan | | | |

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| Conclusion 1<br><br>Combined insecticide application and parasitoid release would be of value only if control was incomplete using insecticides alone, either from a temporal or a spatial perspective. |
| Conclusion 2<br><br>Spatial consideration: For urban, organic, or riparian situation that is close to agriculture that is not treated but is near to conventionally managed agriculture. |
| Conclusion 3<br><br>Temporal consideration:<br><br>(1) As a stop-gap before systemic insecticides become effective.<br><br>(2) In organic agriculture, when pyganic is used, before and after treatment. |
| Conclusion 4<br><br>Ultimately, the use of parasitoids for control will reduce but will not eradicate GWSS. Consequently, parasitoids are of most value where it is possible to live with low populations of GWSS – in other words, away from grapes. Production nurseries could use parasitoids and then treat only material that is to be shipped with insecticide. |

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## Topic I. What chemical and biological factors could provide interference with colonization of the sharpshooter by *Xf*?

| | Name | email | Cell telephone | Hotel |
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| Facilitator | Paulo Zaini | | | |
| Conclusion Recorder | Paulo Zaini | | | |

5 participants

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| Conclusion 1<br>There are no studies comparing the fitness of GWSS when infected or not infected by *Xf*. |
| Conclusion 2<br>A non-virulent *Xf* could be used to block attachment sites in the insect foregut. |
| Conclusion 3<br>As a chemical approach to preventing attachment of *Xf* to the GWSS foregut sites, N-acetyl-glucosamine or derivatives of this compound could be tested for their ability to interfere with binding of *Xf*, which presumably occurs by means of carbohydrate-binding proteins. |
| Conclusion 4<br>Could an endosymbiont be used to deliver antimicrobial compounds that might interfere with colonization of the insect by GWSS? |

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## Topic J. What are the most likely molecular candidates and possible mechanisms for the underlying cause of the typical scorching symptoms induced by *Xf* infection?

| | Name | email | Cell telephone | Hotel |
|---|---|---|---|---|
| Facilitator | Qiang Sun | | | |
| Conclusion Recorder | Jim Lincoln | | | |

Maximum of 5 participants

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| Conclusion 1<br>In general, *Xf* is not found in the areas where scorch has developed. What are some possible explanations for this observation? We provide several speculations.<br>(1) *Xf* invaded the area where scorch develops but migrated away before scorch developed.<br>(2) *Xf* invaded the area where scorch develops but the cells and their contents were destroyed in the process of scorch development.<br>(3) *Xf* delivered, directly or indirectly, a toxic signal to the area that became scorched, and *Xf* never actually reached the area where scorch developed. |
| Conclusion 2<br>For (3), direct delivery would involve (3a) synthesis and secretion of a toxic compound or structure by the *Xf* cell or by the action of something from the *Xf* cell on a plant substance. An example of indirect delivery would be (3b) blockage of vessels in the leaf, resulting in deprivation of water and nutrients distal to the blockage, resulting in a reaction in the leaf lamina, e.g., synthesis of anti-desiccants, which would result in scorch. An experimental observation not consistent with 3b is maintenance of green tissue distal to short radial cuts in the leaf lamina. |
| Conclusion 3<br>An example under 3a would be a postulated release of oligosaccharides by action of *Xf* enzyme(s) and the distal movement of the oligosaccharides to the leaf margin, there inducing scorch. |
| Conclusion 4<br>Another example under 3a would be a postulated release of a colicin from *Xf*. Although colicins are presumed to be offensive anti-microbial compounds targeted to competing bacteria in times of nutrient deprivation, certain colicins have been demonstrated to have anti-tumor capabilities, so a colicin that would adversely affect plant tissue is conceivable. |
| Conclusion 5<br>*Xf* secretes membrane vesicles. Conceivably, these could travel to the leaf margin. Such vesicles are known to contain hemagglutinin-like proteins and MopB, as well as other proteins that could induce scorch. |
| Conclusion 6<br>Could ABA be involved? |

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## Topic K. For Pierce's disease, is there any significant natural or agricultural reservoir for *Xylella fastidiosa* other than grapevine?

| | Name | email | Cell telephone | Hotel |
|---|---|---|---|---|
| Facilitator | Mark Black | | | |
| Conclusion Recorder | Jennifer Parker | | | |

6 participants

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| Conclusion 1<br><br>To qualify as a *Xylella fastidiosa* subsp. *fastidiosa* (*Xff*, grapevine strain) reservoir, the host plant must:<br><br>(1) be systemically colonized to a high bacterial load of at least $10^3$ to $10^4$ cfu/g, and<br><br>(2) support significant vector feeding.<br><br>Such reservoirs are more important in warm climates because winter cold depresses bacterial overwintering elsewhere. |
| Conclusion 2<br><br>Vectors probably are not selective for *Xf* subspecies (*fastidiosa*, *multiplex*, *sandyi*, *pauca*) and probably carry mixtures of supspecies. Plant species vary for *Xf* subspecies selectivity. Grapevine is very selective for *Xff* (grapevine strains). There have been a few experimental exceptions where non-grape isolates [citrus *Xfp* , Hartung; sycamore *Xfm* and oleander (*Xfs*, Black, unpublished)] caused PD symptoms in greenhouse grape with mechanical inoculation, but implications for epidemiology have not been discerned. Weeds, forage legumes, and wildflowers varied for colonization by three subspecies in a screenhouse and in the wild may harbor more than one subspecies simultaneously. |
| Conclusion 3<br><br>Reservoir risk is related to plant species frequency and position (percentage of cover, adjacent crops), but plant corridors (riparia, rights-of-way, fence lines, movements of container-grown ornamentals) also increase vineyard risk. |
| Conclusion 4<br><br>*Xff*-infected vines in active or abandoned vineyards (*V. vinifera*, tolerant cultivars/hybrids), feral vines,and native *Vitis* are significant reservoirs. *Vinca major* is a significant reservoir in CA (discussion participants did not know selectivity for *Xf* subspecies). Certain agricultural and weedy plants are thought to be reservoirs due to potentials for mixed subspecies infections. |

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## Topic L. Follow-up to panel discussion: transgenic approaches to creating *Xf*-resistant grapevine.

| | Name | email | Cell telephone | Hotel |
|---|---|---|---|---|
| Facilitator | David Gilchrist | | | |
| Conclusion Recorder | Gabriel Paulino | | | |

6 participants

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| Conclusion 1<br><br>This area needs an update of the IP landscape to ascertain freedom-to-operate. Perhaps PIPRA should be engaged to identify a list of genes for all of the transgenic resistance gene projects, including a list of those genetic construction components that are in the public domain. |
| Conclusion 2<br><br>There is a need to construct a pathway through the regulatory process for field trials. |
| Conclusion 3<br><br>The value to growers of current efforts in creating resistance to *Xf* could be substantially enhanced by simultaneously introducing another disease control genotype, e.g., to mildew. |

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| Topic M. Follow-up to panel discussion: virulence factors of *Xf* and their possible exploitation for control of Pierce's disease. |
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| | Name | email | Cell telephone | Hotel |
|---|---|---|---|---|
| Facilitator | Michele Igo | | | |
| Conclusion Recorder | Chemira Appaiah | | | |

12 participants

| Conclusion 1<br><br>Since TolC is essential for survival of *Xf in planta*, could it serve as a sensitive model target for strategies aimed at killing *Xf*? |
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| Conclusion 2<br><br>Are there transcription factors or other control mechanisms of *Xf* or the host plant that could be tricked into activating mechanisms for cold clearance of *Xf*? |